REMARKS/ARGUMENTS

The Office Action of August 31, 2009 has been reviewed and carefully considered.

Reconsideration of the above-identified application, as herein amended, is respectfully requested.

Claims 1, 3, 4, 7-11, and 14 are now pending, with claims 1 and 8 being independent. Claims 2, 5, 6, 12, and 13 have been cancelled without prejudice or disclaimer. Claims 1, 3, 4, 7-11, and 14 have been amended. No new matter has been added.

Claims 1-5 are rejected under 35 USC §102(e) as anticipated by Dill (U.S. Patent 7,010,052). Claim 6 is rejected under 35 USC §103(a) as unpatentable over Dill in view of Cedergren (U.S. Patent 7,466,658); claim 7 is rejected as unpatentable over Dill in view of Sayood (U.S. 6,892,343); claims 8-12 are rejected as unpatentable over Dill in view of Waldman (U.S. Patent 4,942,467); claim 13 is rejected as unpatentable over Dill in view of Waldman and Cedergren; and claim 14 is rejected as unpatentable over Dill in view of Waldman and Sayood.

As discussed in the specification, digital communications systems may use separate source and channel coding systems. For example, Figure 1 of the present application depicts the transmission of digital data from a sender (elements 10, 20, and 30) to a receiver having a decoder stage (elements 50, 60) over a transmission channel (40). The sender may include a source (10) of symbols (*i*, *j*, etc.). In a video coder, for example, these symbols may correspond to texture movement coefficients quantized to yield a certain number of discrete values. The source (10) may be followed by a video coder (20) that uses a variable length code (VLC) table to code the symbols as digital data (i.e., that performs <u>source coding</u>). This may be followed by <u>channel coding</u>, e.g., convolutional parallel turbocoding, of the digital data from the coder (20) to protect it against interference induced during its transmission over the channel (40).

Generally speaking, decoding of convolutional codes, such as turbocodes, involves a comparison of probability values for different paths in a decoding trellis. Such probabilities are referred to as *a posteriori* probabilities, because they quantify the likelihood that the received data is one symbol or another and are based on the received data itself. It is also possible to use forward-looking probabilities to help make decoding decisions for digital data, which are referred to as *a priori* probabilities. *A priori* probabilities quantify the likelihood that data yet to be received is going to be one symbol or another. For example, it is possible to determine the probability that a particular symbol will be the next received symbol based on a historical compilation of received symbols, i.e., a histogram.

The embodiments of the invention described in the specification relate to a method of combined channel-source decoding of digital data, i.e., decoding that involves both *a posteriori* and *a priori* probabilities. As shown in Figure 2 of the present application, the receiver includes a combined channel-source decoder (50) which may use, for example, a maximum *a posteriori* (MAP) decoding algorithm. Digital data is fed from the combined decoder (50) to a VLC decoder 60, e.g., an MPEG-4 video decoder, to supply at the output of the decoder an estimate of the values of the symbols (i, j, etc.) from the source (10).

The *a priori* probabilities of the symbols from the source are estimated iteratively by means of a histogram generator (54) and a module for calculating symbol probabilities (55). The histogram generator 54 can indicate the number of transmissions of each symbol or store the previous symbol decoded and indicate the number of transmissions of each successive pair of symbols. The histogram generator (54) can therefore calculate stationary probabilities p(i) and probabilities of transitions between symbols p(i/j). A converter module (56) is provided for symbol-probability to bit-probability conversion using a VLC tree. The module (56) injects bit-level

probabilities into the channel decoder (51). These probabilities are then inserted as *a priori* probabilities into a Max-Log MAP decoding algorithm executed on the trellis of the convolutional decoder (51), where they are used to <u>improve the decoding</u> of the convolutional code. This process resumes on the next turbocode iteration, thereby further refining the source symbol probabilities p(i) and p(i/j) and, consequently, the source *a priori* probabilities used for turbodecoding.

Amended independent claim 1 is directed to "a method of combined source-channel decoding of digital data coding discrete values or symbols (i, j, etc.) received by an input convolutional channel decoder (51) of a digital data turbodecoder (50) from a source (10) over a transmission channel (40)." Claim 1 recites the steps of "applying a priori probabilities (p(i), p(i/j)) associated with said symbols to a channel decoding trellis of said input convolutional channel decoder (51);" and "statistically estimating, at each iteration of the turbo-decoder (50), said a priori probabilities from occurrences of the symbols estimated by said turbodecoder (50)."

The cited Dill reference discloses a circular trellis coded modulation (CTCM) encoder that converts a sequence of digital bits of a predetermined length into a corresponding sequence of channel symbols based on a circular trellis path. A corresponding decoder is also disclosed which uses *a posteriori* probabilities and a BCJR algorithm (see col. 30, lines 31-34).

The decoding method of Dill clearly does not involve <u>estimating *a priori* probabilities</u>, much less estimating them <u>in each iteration of the decoder</u>. Indeed, Dill does not even disclose a decoder that estimates <u>occurrences of the symbols</u>, which is the basis for Applicants' *a priori* probability estimations. Rather, Dill discloses a decoding method based only on <u>*a posteriori*</u> probabilities. The Dill decoding method provides for (a) hard decoding of a sequence of received symbols Y_t,; (b) selection of a decoded symbol having the highest <u>*a posteriori*</u> probability (i.e., the highest probability, $P(Y_t/X_t)$, that the received symbol Y_t corresponds to a

particular transmitted signal X_t); (c) circular shifting of the decoded sequence; and (d) decoding the circular shifted sequence by an iterative circular BCJR algorithm to obtain a corresponding transmitted symbol sequence. (See Dill at col. 8, lines 41-55). Thus, Dill does not disclose "statistically estimating, at each iteration of the turbo-decoder (50), said a priori probabilities from occurrences of the symbols estimated by said turbodecoder (50)," as expressly recited in claim 1.

It is clear from the foregoing that Dill does not disclose the estimation or use of *a priori* probabilities. Consequently, Dill also does not disclose the step of "applying a priori probabilities (p(i), p(i/j)) associated with said symbols to a channel decoding trellis of said input convolutional channel decoder (51)," as further recited in claim 1.

Accordingly, claim 1 is deemed to be patentable over Dill.

The other applied references -- Cedergren, Sayood, and Waldman -- were cited with respect to certain features of the dependent claims. Nothing has been found or pointed out in these references that would remedy the above-discussed shortcomings of Dill with respect to the recited features of claim 1. Furthermore, Dill explicitly teaches away from estimating and/or using *a priori* probabilities, because decoding is performed using "a CTCM decoder coupled to said receiver for decoding the received transmission without knowledge of the starting state of the circular trellis path of the CTCM encoder to recover the sequence of information bits." (Dill, at Abstract). In fact, rather than using estimated *a priori* probabilities, the method disclosed in Dill relies on the assumption that all received symbols have the same probability. (See Dill at col. 34, lines 33-40).

Independent Claim 8, as amended, recites features similar to those of Claim 1 and is, therefore, deemed to be patentable over the applied art for at least the reasons discussed above with respect to claim 1.

The remaining claims in this application are each dependent from one or another of the independent claims discussed above and are therefore believed to be patentable over the cited art for at least the same reasons. Since each dependent claim also defines an additional aspect of the invention, reconsideration of the patentability of each on its own merits is requested.

In view of the foregoing amendments and remarks, Applicants request favorable reconsideration and early passage to issue of the present application.

Respectfully submitted,
COHEN PONTANI LIEBERMAN & PAVANE LLP

By /Lance J. Lieberman/
Lance J. Lieberman
Reg. No. 28,437
551 Fifth Avenue, Suite 1210
New York, New York 10176
(212) 687-2770

Dated: March 1, 2010